NAVAL PILOT TRAINING SYSTEM STUDY. VOLUME III. EXECUTIVE SUMMARY

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Binghamton, New York

December 1972

Technical Report: NAVTRAEQUIPCEN 72-C-0049-1

NAVAL PILOT TRAINING SYSTEM STUDY

VOLUME III OF III

EXECUTIVE SUMMARY

Singer
Simulation Products Division
Binghamton, New York
Contract N61339-72-C-0049
NAVTRAEQUIPCEN Task 2755-01

North American Aviation
Columbus Division
Columbus, Ohio
Contract N61339-70-C-0136
NAVTRAEQUIPCEN Task 8504-4

December 1972

NAVAL TRAINING EQUIPMENT CENTER
ORLANDO, FLORIDA 32813

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY *(Corporate author)*

The Singer Company, Simulation Products Division
North American Aviation, Columbus Division

2a. REPORT SECURITY CLASSIFICATION: Unclassified

2b. GROUP

3 REPORT TITLE

NAVAL PILOT TRAINING SYSTEMS DESIGN STUDY
Volume III of III
EXECUTIVE SUMMARY

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Basic Report (Three volumes)

5 AUTHOR(S) *(First name, middle initial, last name)*

H. W. Erickson and others

6 REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
December 1972		

8a CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)
N61339-72-C-0049 and N61339-70-C-0136	
b PROJECT NO: 2755-01P01 and 8504-4	NAVTRAEQUIPCEN 72-C-0049-1
c	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	

10 DISTRIBUTION STATEMENT

Approved for public release; distribution is unlimited.

11 SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
There are three reports in this series. The other two reports are: NAVTRADEVCEN 72-C-0049-1, Vol I of III and NAVTRADEVCEN 72-C-0049-1, Vol II of III.	Naval Training Device Center, Orlando, Florida 32813

13 ABSTRACT

This study defined a cost effective program for training Naval fixed-wing pilots during the 1974-1986 time frame. It identified requirements for the Undergraduate Pilot Training program anticipated for that period, and evaluated elements of the current program, and the educational and training technologies for their ability to economically fulfill them. The behavior objectives of the future program were defined through the analysis of the flight tasks trained in the present program, likely to be relevant in the future. Major system elements having significant impact on the development of these objectives were identified, and recommendations developed for restructuring the program to reduce cost while maintaining current levels of pilot proficiency. Recommendations are submitted to:

1. Revise the Primary flight training program to provide more training in less expensive aircraft and provide an improved basis for pipeline assignment.
2. Reduce the variety of aircraft types and models from nine to four, retaining the T-2C, the TA-4J and the TS-2A and replacing the T-34B with an instrumented turbine-powered propeller aircraft.
3. Accelerate the procurement of modern ground trainers and flight simulators, making maximum use of automated training and visual and motion simulation.
4. Institute a program to systematically validate and introduce specific study recommendations.

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UNCLASSIFIED

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Naval Pilot Training						
Pilot training						
Simulation						
Training						
Training aircraft						
Training devices						
Training system						

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EXECUTIVE SUMMARY

INTRODUCTION

This study investigated the Naval Undergraduate Pilot (fixed-wing) Training (UPT) Program and produced recommendations for the modification of the program to reduce cost while maintaining the current level of graduate quality. The study analyzed the capabilities of elements of the current system, the pilot training requirements anticipated for the 1974-1986 time period, and capabilities within the pilot training state of the art for economically fulfilling those requirements.

Six training system elements, selected for their discrete impact on system cost, training effectiveness and susceptibility to analysis and improvement were evaluated:

A. Behavioral objectives of the program

B. Training methods employed in their achievement

C. Syllabus structure by which training is administered

D. Aircraft

E. Training aids and devices used in training

F. The organization of the total training system

Two criteria were established for the evaluation of each system element and for the selection of new or modified elements. They are training effectiveness and training cost.

METHOD

A study team was made up of personnel from North American Rockwell Corporation's Columbus Division and from the Singer Company's Simulation Products Division. A study Steering Committee was established, consisting of personnel representing the Office of the Chief of Naval Operations, the Staff of the Chief of Naval Air Training and the Naval Training Device Center. The study team, with the cooperation and guidance of the Steering Committee, reviewed the current undergraduate fixed-wing pilot training system in detail. Requirements for training and potential constraints on the training system were anticipated for the 1974-1986 time frame. Capabilities were evaluated for meeting those requirements within the constraints likely to exist at that time. Recommendations were developed for improvements to current system practices and for the adoption of new training approaches. These were reviewed with the Steering Committee, and the final conclusions and recommendations have been incorporated in this summary.

PROCEDURE

An itemized work plan assured the systematic review and analysis of data relevant to the development of training system concepts for the 1974-1986 time frame. It consisted of nine interrelated tasks, as follows:

TASK I. Accumulate/Review Current Training Literature and Related Data

The training and training research literature relevant to both military and civilian pilot training was reviewed. Problems and approaches unique to pilot training were identified for later evaluation as to their implications for the future UPT program. Literature pertaining to the current training program was reviewed for the identification of essential training system considerations.

TASK II. Definition of the Current Navy System

The UPT program was reviewed to develop an understanding of the essential characteristics and constraints on the training system. This review included familiarization with the present training system structure. Interviews were conducted with students, instructors, and training administrators within the current program. The training objectives of the program were defined through analysis of the tasks assigned in the current flight training syllabus, and of the academic, flight support, and flight training materials currently employed in Navy pilot training.

TASK III. Define Future Training Requirements

Requirements for Naval pilot training in the 1974-1986 time period were defined through interviews with CNATRA, Fleet, and CNO planning personnel, and from a review of the characteristics of the aircraft, missions, and mission environments anticipated for that period. Unique constraints on training during that period were also defined to facilitate the selection and organization of system elements having not only training validity but practicality and feasibility as well.

TASK IV. Review State of the Art

Current and potential capabilities for the improvement of pilot training, and for the reduction of pilot training costs, were reviewed. Both formal research efforts and less formal experiences were reviewed in the definition of approaches likely to contribute to the cost-effectiveness of the program in the future. Emphasis was placed on evaluating programmed instruction, automated instruction, training aircraft and

training devices for their potential for improving training and for reducing training costs.

TASK V. Evaluate Current System

The present UPT program was evaluated for its ability to fulfill training requirements foreseen for the 1974-1986 time period. The evaluations were based on reviews of training materials, selected observations of training, and interviews with administrators, instructors, and students, primarily within the jet pipeline. Interviews were also conducted with Fleet personnel, both on the nature of the future training situation and on the validity of the current program with respect to present and future requirements. System evaluations were oriented toward elements of the training system having most direct impact on training effectiveness and cost, and having potential for improvement.

TASK VI. Synthesize Future System Alternatives

As data were collected and correlated on the requirements and circumstances anticipated for the future and on possible improvements to the training program, specific modified training concepts were defined. Each of these was developed as a means of improving training effectiveness and/or training economy, with a minimum of consideration given to the potential interactions among concepts. A number of logical mixes of aircraft, syllabus approaches, training devices, training methods, and training organization structures were prepared. These were analyzed to determine the relative feasibility of each mix.

TASK VII. Evaluation of Alternative Future System Configurations

Each element of the alternatives evaluated was selected and conceived to influence some aspect of training effectiveness, and/or to reduce the cost of training. Each possible system alternative was constructed to utilize these improved elements, in a logical and systematic training system structure. The evaluation of alternatives compared the ability of each of these synthetic systems to fulfill the training objectives of the future program, and the relative cost and feasibility of each within the Navy command structure.

TASK VIII. Recommendation of an Advanced Training System Configuration

From the alternative future system configurations, two pipeline systems were selected. Each incorporated recommendations for improvements in training methods, syllabus, aircraft, training devices, and system organization and integration.

Recommendations are submitted for a near-term modification of the program, to permit an orderly and cost-effective transition from current to advanced approaches. Recommendations are also made for a far-term program, incorporating advanced features not available for the near-term system.

TASK IX. Recommendations for Further Investigation and Test

Many of the training concepts developed during the study have never been evaluated within the context of Naval pilot training. Recommendations were made for the experimental evaluation of each of these concepts prior to their adoption in the pilot training program. An implementation plan was prepared, indicating the time phasing, and the funding required to systematically and economically modify the current program to make best use of the training/technology and of the assets available to the program both now and in the future.

RESULTS

Data collected during the period of the study were organized to provide a coherent and meaningful picture of the current pilot training program, and of requirements on and capabilities for the program in the future. Data were organized around six basic system considerations:

A. Behavioral Objectives. An analysis of specific behavioral objectives in the current program concentrated on flight tasks and skills associated with the current pilot training syllabus. Table 17, Section 4.2.1.1 in Volume I summarizes the flight training objectives anticipated for the future program. Flight training objectives and tasks were analyzed to define the most critical and most costly functions of the program. This served to focus attention in the analysis of current and future program requirements on the elements having the most impact on these functions.

B. Training Methods. The methods employed in training involve decisions having direct impact on training effectiveness and cost. The way in which the learning situation is controlled, the timing and quality of feedback to the student, and the way in which new information and tasks are presented all directly influence training effectiveness. They also influence cost, particularly as they relate to training time. Cost is also influenced by the requirements, in the method chosen, for instructor participation and training, and for use of the aircraft and related flight facilities.

The methods used in the current program, during the data collection period, were in a process of evolution. Traditional methods were being modified to make training more objective, that is, more closely related to specific behavioral objectives, and less dependent on skilled instructor personnel, particularly in the academic training phases.

In academic and flight support training, increased use is being made of programmed instructional methods. Some automated instruction is being used in connection with some of the program's training devices. In both areas, current training practices do not represent the current state of the art. As a result, recommendations are included in this report, for the adoption of advanced training methods expected to be available during the study time period, to assure the employment of the best training technology available.

C. Syllabus. Two syllabus structures are employed in the current fixed-wing pilot training program. One syllabus prepares students for transition to VF/VA (fighter/attack) units, the other for transition to VS/VP (ASW/patrol) units. The unique

requirements of each type of unit are reflected in the aircraft and tasks used in training. In Primary and Basic, essentially the same skills are trained for both pipelines, with specialized training given in Advanced. Similar pipeline requirements are foreseen for the program through 1986, with some changes required to reflect the transition of selected units from propeller to jet aircraft in VS/VP units. Syllabus changes are also indicated to permit later and more accurate selection of candidates for the VF/VA and VS/VP pipelines. These will permit student exposure to a wider range of flight tasks in the Primary flight syllabus, to facilitate evaluations of adaptability to the unique features of the two programs. Later pipeline selection, and selection based on a broader task basis, is expected to reduce attrition in the Advanced phases of training, and in later training in Fleet units. Figure 1 represents the syllabus developed to reflect the training requirements and capabilities anticipated for the latter half of the time period studied. The Primary phase has been expanded to include a broader spectrum of flight training tasks, to be trained in a relatively inexpensive aircraft. The expansion of Primary will facilitate screening, and reduce the cost of training by accomplishing a greater proportion of the total training in a less expensive aircraft. Common Primary and Basic phases are incorporated in this syllabus, with pipeline selection taking place after Basic. Different Advanced phases are used to provide training in the fundamental skills associated with the VF/VA and VS/VP roles.

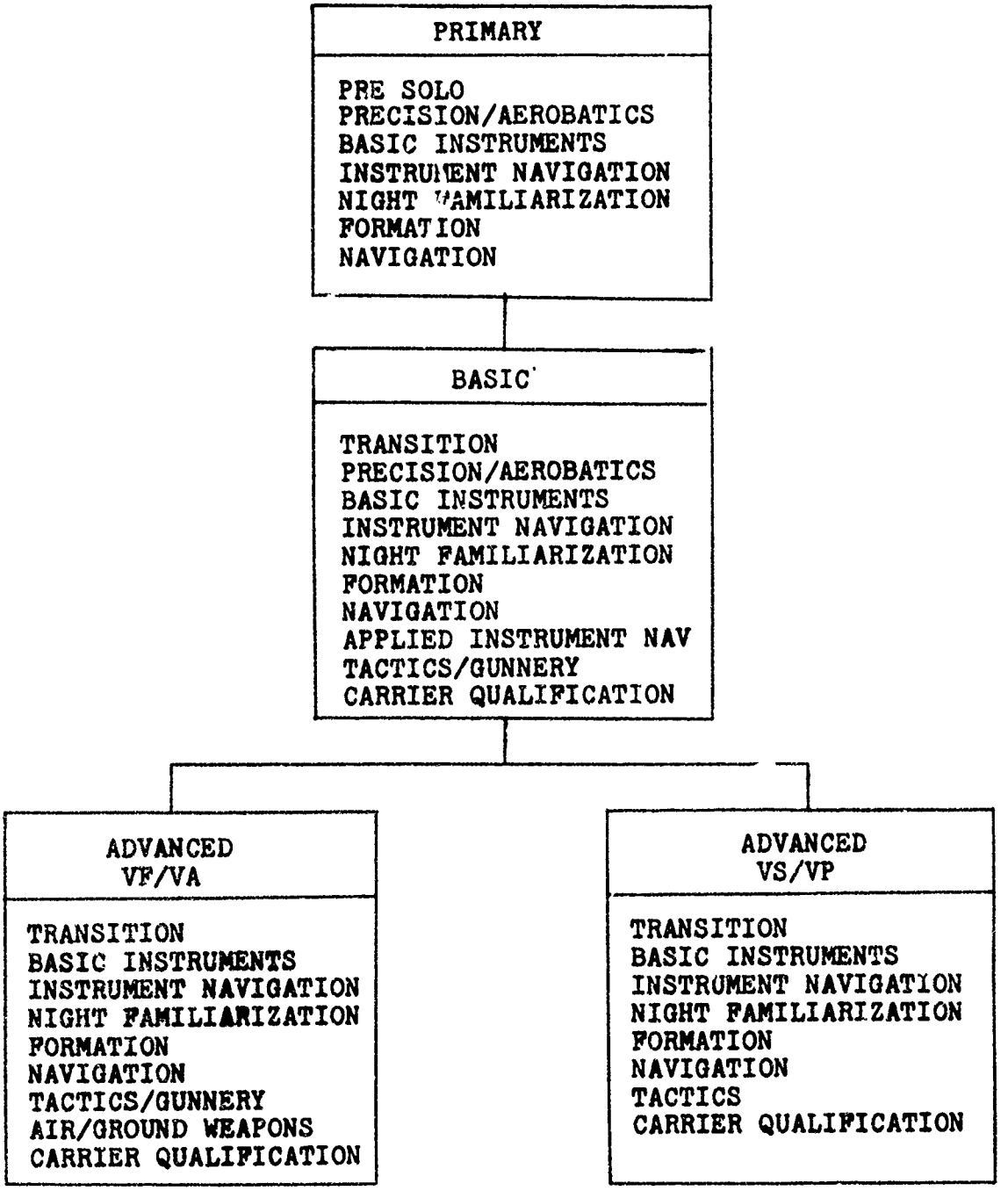


Figure 1. Far-Term Recommended Syllabus

Because of budgetary and administrative constraints and to make optimum use of current resources, an interim, near-term syllabus (Figure 2) was developed. This syllabus for the period 1974-1980, will facilitate a smooth transition from the current syllabus to the one developed for the far-term (Figure 1). The near-term syllabus employs a Primary program similar to that currently in use, with T-34B aircraft remaining in the inventory. The VF/VA and VS/VP Basic programs include identical tasks, within the capabilities of the T-2B/C and T-28B/C aircraft (see Figure 3). The Advanced programs are differentiated in employing the TA-4J aircraft in the VF/VA pipeline, and the TS-2A in the VS/VP pipeline with flight tasks allocated according to the specific requirements of the respective pipelines. The principal difference between the current syllabus and the near-term syllabus is in the extent to which training devices are employed. Flight time requirements are reduced from 277 hours in the current VF/VA pipeline to 191.5 hours in the near-term system, and from 265.8 hours in the current VS/VP pipeline to 201.2 hours in the near-term system, by the substitution of simulator time for flight time (Figure 4.) In the far-term system flight time requirments are further reduced to 139.1 hours in the VS/VP system and 150.2 hours in the VF/VA program.

Figure 7 summarizes the major characteristics of the current, near-term, and far-term programs for comparison as to training time, aircraft and device utilization, and major pipeline considerations.

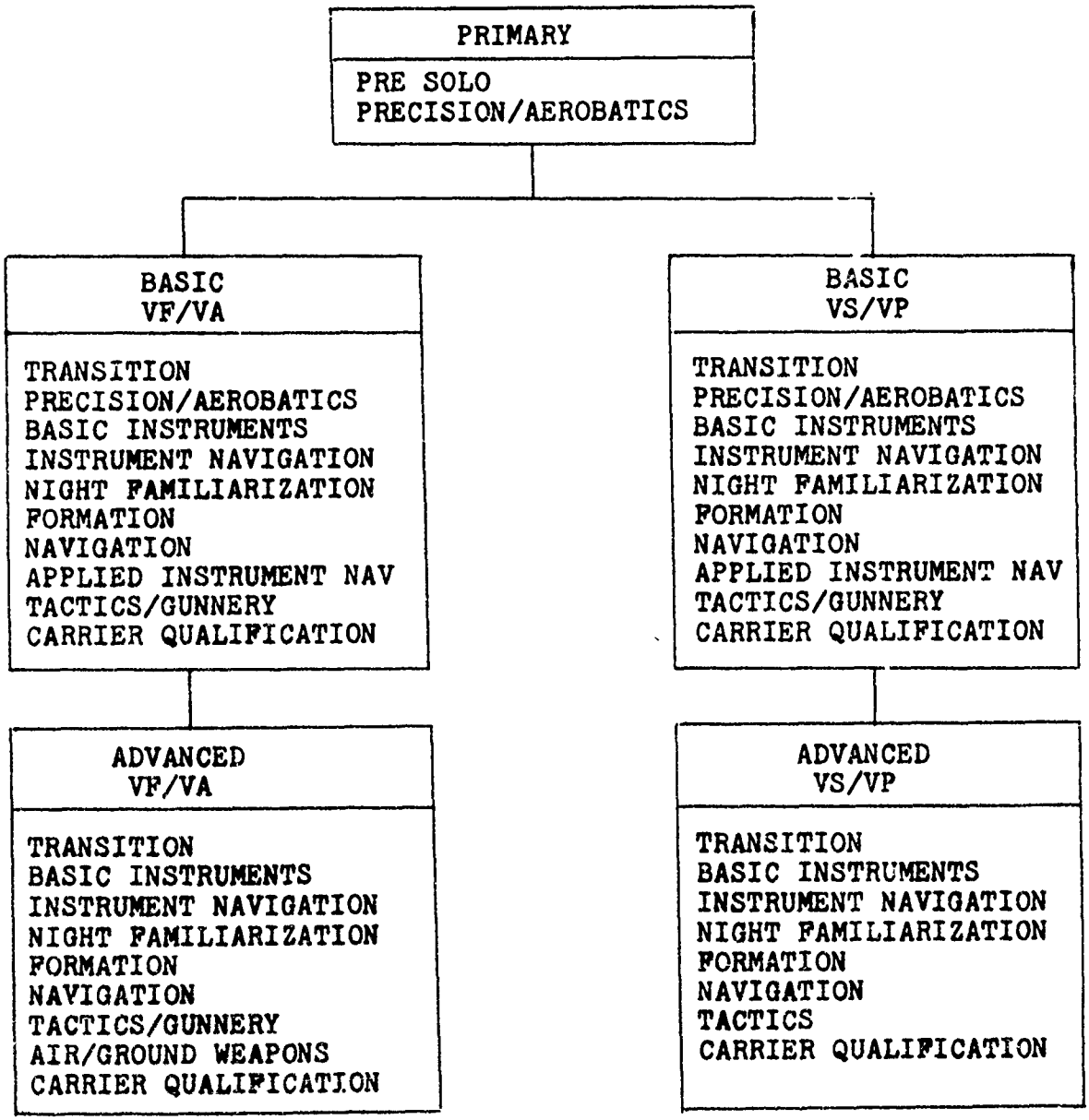


Figure 2. Near-Term Syllabus

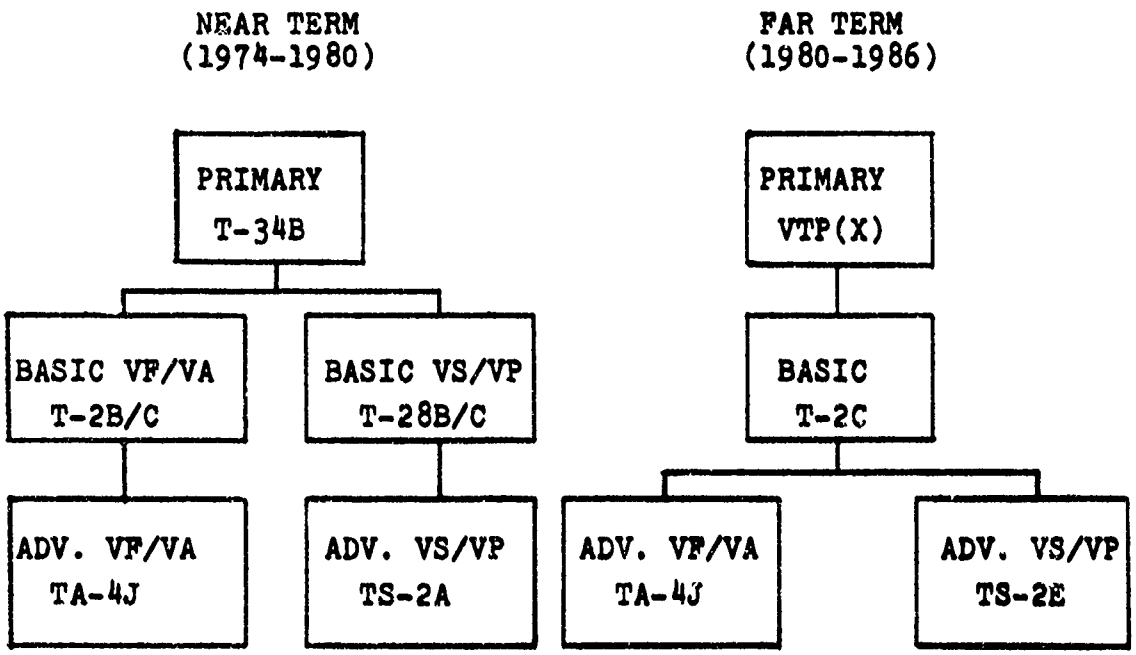


Figure 3. Future Aircraft Assignments

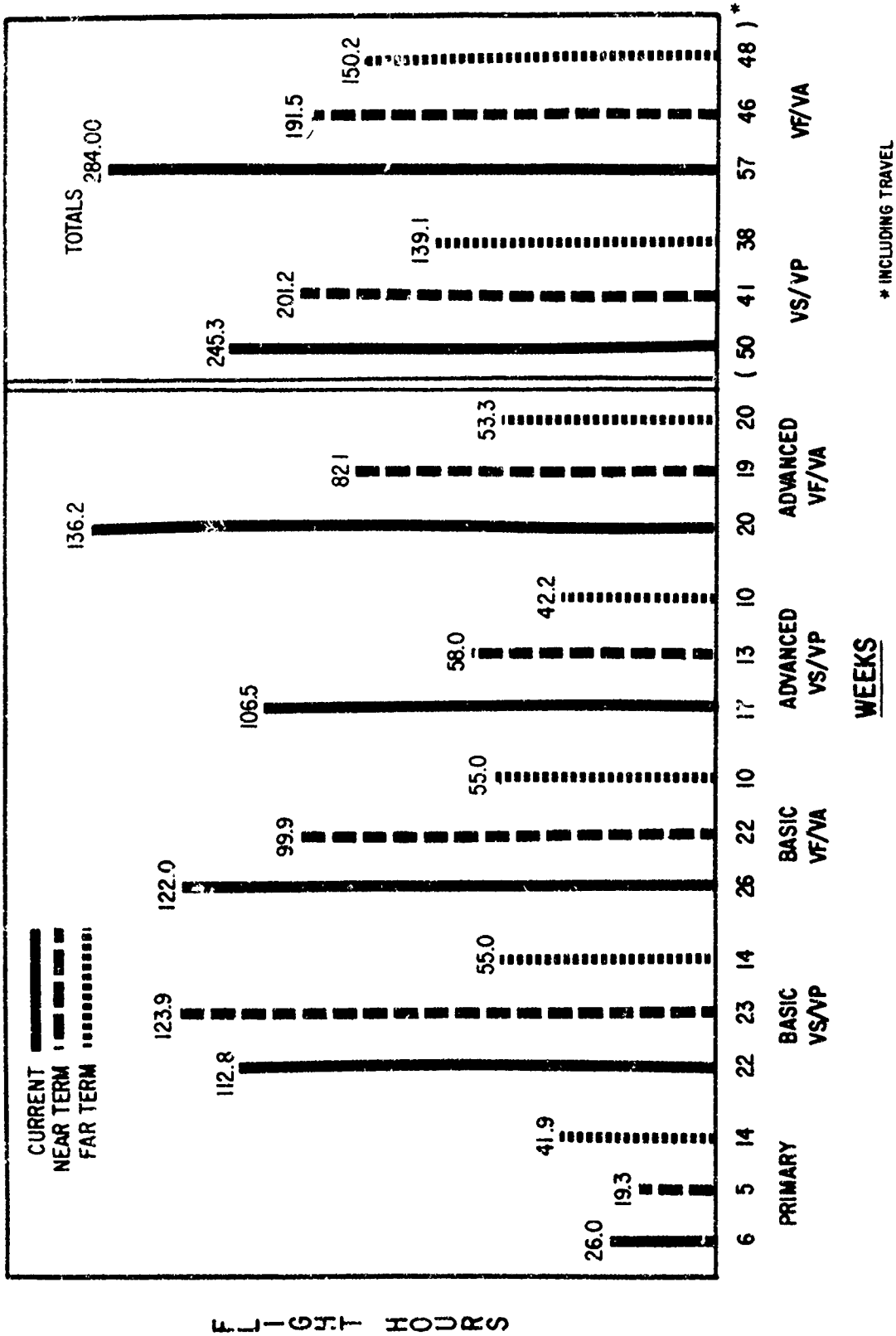
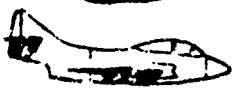


Figure 4. Current and Projected Flight and Training Time

D. Aircraft. Currently, nine types and models of aircraft are employed in the fixed-wing program (Figure 5). The multiplicity of types is based more on aircraft availability than on training requirements, and has led to excessive operating and maintenance costs, and to the fragmentation of the syllabus structure. As a result, the smallest portion of the total flight training syllabus is accomplished in the least expensive aircraft, due primarily to the limited capabilities of that aircraft, the T-34B. In the jet program, about half of the remaining training is given in the most expensive aircraft, the TA-4J. The analysis of future training objectives and of the task settings required to fulfill them led to the conclusion that a significantly larger portion of the total training could be provided in less complex and less expensive aircraft than the TA-4J. Basic flight training, in the jet pipeline, is broken into two phases, to permit utilization of the T-2A in a "soft" role, where it is not exposed to carrier and tactical operations which are inconsistent with its structural capabilities. The T-28, used in VS/VP Basic flying, and the T-34B used in the Primary syllabus are both out of production, and are not responsive to current or future training requirements. Training effectiveness and training cost dictate a reduction in the number of aircraft types used in the program.

Any aircraft developed to replace the T-34B in the Primary program should be able to provide more extensive training than is currently accomplished in Primary. This will permit more efficient identification of students capable of completing the Advanced program, and it will facilitate the selection of students for the two pipelines, by providing a broader base of flight skills on which to make these judgments. Currently, assignments to VS/VP or VP/VA training are based on performance in a limited range of tasks, tending to induce more attrition in the Basic program, of students incapable of grasping the more complex flight tasks currently introduced in Basic.

CURRENT AIRCRAFT	DESIG-NATION	CURRENT USE	INTRODUCED IN NATRACOM	PRODUCTION STATUS	REQ. TO SUPPORT CURRENT SYLLABUS (2350 PTR)
	T-34B (127)*	PRIMARY	1956	CLOSED	121
	T-28B (160)	PROP BASIC	1954	CLOSED	322
	T-28C (123)	PROP BASIC (CQ)	1954	CLOSED	
	T-2A (45) (1)	JET BASIC	1959	CLOSED	105
	T-2B (81)	JET BASIC	1966	CLOSED	279 (2)
	T-2C (73)	JET BASIC	1970	OPEN	
	TF-9J (171) (1)	JET ADV.	1957	CLOSED	133 (3)
	TA-4J (121)	JET ADV.	1970	OPEN	233/350 (4)
	TS-2A (114)	PROP ADV.	1954	CLOSED	132

*CURRENT ASSETS

NOTE:
1. AIRCRAFT ARE IN THE PROCESS OF BEING PHASED OUT AND REPLACED BY OTHER AIRCRAFT CURRENTLY IN THE INVENTORY.
2. BASED ON COMPLETE PHASE-OUT OF T-2A
3. BASED ON PROVIDING 1/3 OF JET PTR (DUE TO PHASE-OUT PROGRAM).
4. FIRST FIGURE REPRESENTS REQUIREMENT FOR PROVIDING 2/3 OF JET PILOTS REQUIRED; SECOND FIGURE REPRESENTS REQUIREMENT FOR PROVIDING ALL JET PILOTS REQUIRED.

Figure 5. Current Undergraduate Pilot Training Program Aircraft

Of the nine aircraft types currently in use, only two are still in production, while two others are in the process of being phased out of the program. The two aircraft still in production, the T-2C and the TA-4J, are responsive to requirements anticipated for the future program and so can continue to be employed effectively. The propeller aircraft, the T-34B, T-28, and the TS-2A, will not be available in sufficient numbers to support any future training program, although the TS-2A's may be replaced by S-2E aircraft, as they are replaced by advanced aircraft in the Fleet. No replacement exists for the T-34B or the T-28B/C. Procurement of replacements for these aircraft will be necessary, as will procurement of additional T-2 and TA-4 aircraft, to support the anticipated Pilot Training Rate.

E. Training Aids and Devices. Training aids, and particularly the more complex training devices, can markedly reduce the cost of training, and improve its efficiency. Many training aids and devices employed in the current program provide effective training, but, with minor exceptions, they do not represent the technology currently available. As a result, their support to the current program is less than the current state of the art could provide.

The design and allocation of training devices must be based on specific training requirements, and on the characteristics of the system in which they will be employed. The flight training objectives of the current program were analyzed to determine their relevance for the future program, and to identify the training situation elements required to fulfill them. Requirements were identified for updating current training aids and training aid concepts, and for the development of new training devices. Training device support to the current program, except for that associated with Device 2F90 needs improvement. 2F90 support to the TA-4J can be significantly improved by the addition of a visual system capability, and by the improvement of its automated training features. Other current familiarization trainers, procedures trainers, instrument trainers, and operational flight trainers have no significant applicability to the future program.

The development of training aids and devices is recommended, to improve learning at all levels of training from academic through flight support and flight training. Recommendations are submitted for the development and employment of automated audio-visual training devices, cockpit familiarization and procedures trainers, and flight simulators. Tables 1 through 3 summarize the current, near- and far-term programs, and include the simulators and major devices currently in use and recommended for the future. The flight and training time requirements reflect the impact of simulation in the near- and far-term programs, as

compared with each other and with the current program. Because of the impact of simulation and reduced use of the TA-4J and the TS-2A, it is estimated that the near term program will cost $60M per year less than the current program, with the far-term system saving an additional $12M per year.

TABLE 1. SUMMARY OF NAVAL PILOT TRAINING - CURRENT SYSTEM *

PHASE	AIR-CRAFT	GROUND TRAINERS			FLT.HRS.		WEEKS**	
		CFT	CPT	BIT/OFT				
PRIMARY	T-34B	12BK15	-	-	26.0		6.0	
BASIC VS/VP	T-28	12BK14	-	2B21	112.8		22.0	
BASIC VF/VA	T-2A/ B/C	-	2C19	2F23	122.0		26.0	
ADVANCED VS/VP	TS-2A	-	2C5A	2B13	127.0		17.0	
ADVANCED VF/VA	TA-4J	-	-	2F90	129.0		20.0	
					VS/VP	VA/VF	VS/VP	VA/VF
TOTAL					265.8	277.0	50***	57***

* THE TF-9J IS EXCLUDED BECAUSE IT IS CURRENTLY BEING PHASED OUT OF THE ADVANCED PROGRAM.

** FLIGHT TRAINING ONLY

*** INCLUDING TRAVEL

TABLE 2. SUMMARY OF NAVAL PILOT TRAINING - NEAR TERM

PHASE	AIR-CRAFT	GROUND TRAINERS			FLIGHT HOURS		WEEKS*	
		CFT	CPT	OFT				
PRIMARY	T-34	12BK13	-	2FT34G	19.3		5.0	
BASIC VS/VP	T-28	12BK14	-	2B21	123.9		23.0	
BASIC VA/VF	T-2B/C	12BKT2C	2CT2C	2F101(A)	99.9		22.0	
ADVANCED VS/VP	TS-2A	12BKTS2	2C5A	2FTS2	58.0		13.0	
ADVANCED VA/VF	TA-4J	12BKTA4	2CTA4	2F90(A)	72.3		19.0	
					VS/VP	VA/VF	VS/VP	VA/VF
TOTAL					201.2	191.5	41**	46**

* FLIGHT TRAINING ONLY

** INCLUDING TRAVEL

TABLE 3. SUMMARY OF NAVAL PILOT TRAINING - FAR TERM

PHASE	AIR-CRAFT	GROUND TRAINERS			FLIGHT HOURS		WEEKS*	
		CFT	CPT	OFT				
PRIMARY	VTP(X)	12BKVTP	2CVTP	2FVTPA 2FVTPB	41.9		14	
BASIC	T-2C	12BKT2C	2CT2C	2F101A 2F101B	55.0		14	
ADVANCED VS/VP	TS2-E	12BKTS2	2C5A	2FTS2CA 2FTS2CB	42.2		10	
ADVANCED VF/VA	TA-4J	12BKTA4	2CTA4	2F90(A) 2F90(B)	53.3		20	
					VS/VP	VF/VA	VS/VP	VA/VF
TOTAL					139.1	150.2	38**	48**

* FLIGHT TRAINING ONLY

** INCLUDING TRAVEL

The selection of simulator designs for most cost-effective training was initiated by identifying the training situation elements essential to training each of the procedures, maneuvers, and tasks to be trained in the future undergraduate program. Nineteen simulator design concepts were developed, having various levels of complexity, cost and applicability. A computer program was developed to permit comparison of the training and cost impacts of these device concepts. Three basic simulator types were found relevant to the near- and far-term programs. These are designated simulators "G", "A" and "B". Simulator "G" is essentially a GAT-1* instrument trainer, with a simple visual system capable of supporting training in landing and takeoff. Simulator "A" has a three-degree-of-freedom motion system and a visual system with a 28-degree vertical by 48-degree horizontal field of view. Simulator "B" has a six-degree-of-freedom motion system and a visual system whose field of view is 87-degrees vertically and 180-degrees horizontally. Simulator "B" can support a greater proportion of training than Simulator "A", but its cost and development time are greater. Simulator "A" can replace about 28% of the time normally required in the aircraft, while Simulator "B" can replace an additional 17% because of its greater applicability.

Analysis of simulator utilization requirements indicated that optimum training economy can be realized by employing a mix of simulators of varying complexity and application. Figure 5 represents the recommended mix of "A" and "B" type devices for the near- and far-term systems. Simulator "G", associated with the near-term Primary phase, will support T-34B training until the T-34B is phased out, to be replaced with a more complex device to support the new Primary aircraft and an expanded Primary syllabus. Although the simulators designated "B" can substitute for twice as much flight time as those designated "A" the expense of the device having the greater capability outweighs its utility across the entire syllabus. A mix of devices permits the more complex devices to be employed in the more complex tasks, with the simpler devices relieving them of the less complex training functions. The 2F101(A), for example, can support training in the transition and instrument stages, with the 2F101(B) supporting training in formation, tactics, gunnery, and other maneuvers having similarly complex visual cue requirements. Employing the 2F101(B) in all stages would waste much of its complexity and expense.

* Trademark, Singer-Simulation Products Division, Inc.

The 2F90 OFT, currently employed in the TA-4J program, can be updated with a visual simulation system and with more sophisticated automated training capabilities. This is designated in Figure 6 as 2F90(A), indicating the addition of the simpler visual system, and 2F90(B), with the more complex visual system.

Training requirements and the weight of these visual systems also indicates a requirement for a new motion base for the 2F90, for each visual system modification.

F. System Organization and Integration. The organization of personnel, facilities, and equipment in the current training program is not optimized either for system effectiveness or economy. Divisions of responsibility make it difficult to coordinate efforts in the implementation of specific flight training objectives, because the responsibility for flight training at a given base is assigned to a different organization and a different chain of command than those responsible for related ground training. As a result, attempts to optimize ground training are oriented toward intermediate student and system performance criteria, rather than toward the ultimate criteria established by the flight tasks required of the student. Also, organizational problems currently make it difficult for the personnel responsible for the development of flight skills to directly employ ground facilities and devices in developing these skills.

Data flow within the current program is also deficient in supporting day-by-day decisions on the conduct of training, and in supporting long-term system evaluations and modifications. Data are required to provide performance feedback to the student, and to the instructor to facilitate guidance and the scheduling of training. Data are also required to permit continuous evaluations of major syllabus components. Currently, these data are not available on a timely basis, or in sufficient detail to support scheduling or system evaluations.

The current assignment of training phases to bases and the manner in which students flow through the program, from base to base and from squadron to squadron, produce costs and inefficiencies which can be reduced by modifying current phase- and squadron-to-base allocations. In the present system, jet students completing the Primary flight phase report to a new squadron at a new base for the first phase of Basic flight training. Because of the age and limited capabilities of the aircraft employed in Basic Phase A, the student receives only that training consistent with the durability of the aircraft, moving to a third squadron for Basic Phase B. During Phase B, he must make an additional move to a fourth squadron, in another area, for gunnery and carrier qualification. Finally, he moves to a fifth squadron, in

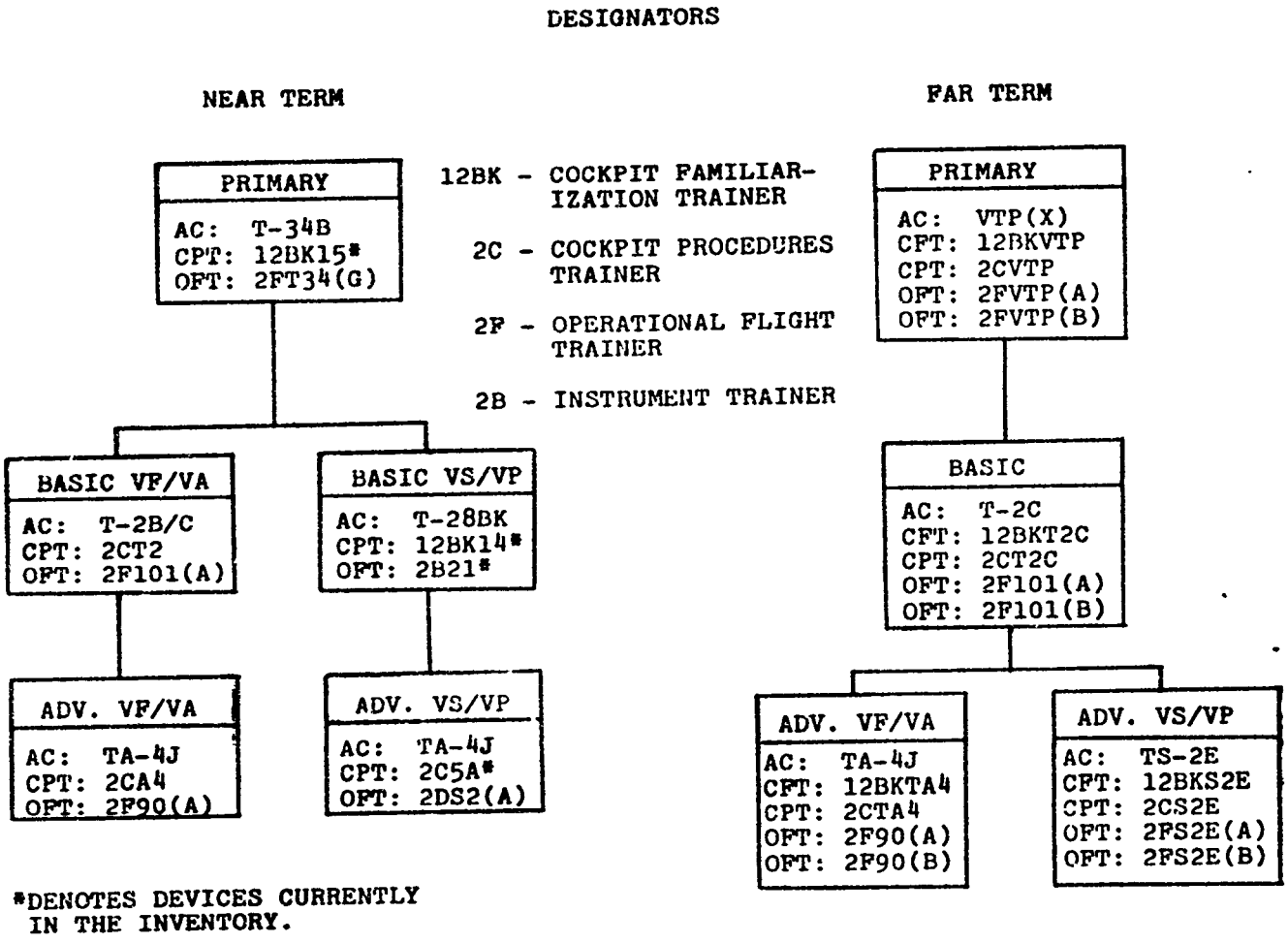


Figure 6. Recommended Training Devices

another geographical area, for Advanced training. The cost of this procedure is due in part to the cost of travel and of the non-training time necessary to accomplish check-out, travel, check-in, and transition to local flying procedures. It is due also to the fact that, in the current series-flow system, delays or other perturbations in one squadron, area, base, or phase influence everything occurring later on in the program. Bad weather at Meridian, for example, delays students going to VT-4 at Pensacola, which in turn delays students entering VT-21 and VT-22 at Kingsville. In addition, delaying students going to VT-4 may produce a conflict with the carrier schedule, making it necessary for the carrier to operate at reduced efficiency while at Pensacola, and for some students to proceed to Advanced without qualifying in carrier operations in the T-2. In a parallel system, events in one geographical area would be less likely to influence flow in the system in other training areas.

Various ways were evaluated for reducing requirements for travel from one base and from one squadron to another. Recommendations are made for consolidation of Basic and Advanced Training at the same base, and for replacing the current series flow with a system employing parallel flow. In this arrangement, students make a minimum of transfers from one place to another. Ideally, implementation of the single base concept would keep students at one base through flight training. This is not totally feasible in the period considered in the study, but adoption of a partial parallel flow system is feasible within the capabilities and constraints anticipated for that period.

Recommendations are submitted in this report for modifications to the current NATRACOM organizational structure, to redefine levels of responsibility and to realign some essential functions. A major modification is required to orient the training program more directly to the flight skills required of the designated aviator. Training in flight skills is by far the most expensive aspect of the training program, and has a significant impact on the effectiveness of Fleet units. A single-base type of structure is recommended, with parallel training squadrons operating at the same location, to facilitate emphasis on flight skills. A number of constraints preclude total implementation of this recommendation, but a realignment is possible which will reduce student travel between flight phases and which will reduce the effects of perturbations in training in one area or squadron on others downstream in the program.

Current training system organization places flight training responsibility on the squadron, with responsibility for ground-based training on the training base organization. Each organization reports to a different part of the training command, with communication between the two working organizations at a minimum. It is recommended that a single commander be designated

at each training base, responsible for all of the pilot training carried on at that base. This will facilitate coordination, particularly between flight and flight support training, where a requirement exists for greater use of ground training devices in support of specifitc flight task problems with specific students.

An implementation plan is presented whereby a smooth transition can be made from the current system to that required by the end of the 1974-1986 period. The implementation plan provides for gradual paralleling of training squadrons, to be completed in FY 1974, with single-basing of Basic and Advanced completed late in the study time period (1980-1986). It will be necessary to maintain limited production of TA-4J and T-2C aircraft to replace TF-4J's and T-2A's. T-28 aircraft are to be employed in the experimental development of the syllabus to be used with a new (VTP(X)) Primary aircraft. The VTP(X) itself should be procured beginning in FY 1977, to replace T-34's retired at the end of their service life.

A program of experimentation is recommended to verify recommended syllabus modifications, and to validate estimates of simulator capabilities for replacing flight time. It is estimated that the undergraduate pilot training program plus implementation of program changes will cost approximately $1764M over the next twelve years, including the cost of aircraft, training devices and experimental operations. The overall cost of training, including the implementation program, will be reduced, however, by 60-70 million dollars per year, depending on the training pipeline considered.

CONCLUSIONS AND RECOMMENDATIONS

The study defined the training system elements having impact on training effectiveness, time, and cost. Methods of improving each of these elements were evaluated within the total training system context.

Recommendations are submitted for the improvement of the Naval Undergraduate Pilot Training (fixed-wing) Program through the development of new training aircraft, advanced ground training systems and the optimum utilization of available training assets. Figure 7 summarizes the recommendations for the near- and farterm syllabus, as they compare with the current fixed wing undergraduate pilot training program. Major recommendations include:

1. Expand the Primary syllabus to include instrument and formation flying. This will provide a broader and more relevant base of skills for pipeline selection, and it will provide a greater proportion of training in less expensive aircraft.

2. Provide training in the Primary and Basic phases, common to both VF/VA and VS/VP pipeline requirements, with specialized training in the Advanced Phase.

3. Replace T-34B Primary Aircraft with an instrumented turbine-powered propeller aircraft.

4. Continue to phase out T-2A, T-28A and TF-9 aircraft, replacing them with T-2C and TA-4J aircraft; continue the use of TS-2's in VS/VP Advanced; initiate a program to replace TS-2's with a modern, multi-engine aircraft appropriate to VS/VP requirements.

5. Accelerate procurement of ground trainers and flight simulators employing advanced capabilities for visual and motion simulation and automated instruction, to expand the applicability of ground training in flight skills and to reduce flying time.

In addition to these relatively specific recommendations, suggestions are submitted for the realignment of the current training organization to:

1. Establish a single point of responsibility, at each training base, for both ground and flight training,

2. Institute a parallel training flow system, with both Basic and Advanced training provided at the same base, and

3. Initiate a systematic program to implement and validate the study recommendations.

WEEKS OF TRAINING	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

CURRENT SYSTEM

PRIMARY

CPT: 12BK13	CPT: NONE	OPT: NONE	AC T-34B

PRIMARY ACADEMICS	
PRESOLO	PRECISION/ACROBATICS
CPT Hrs: 3.0 OPT Hrs: 6.9	OPT Hrs: 0.0
CPT Hrs: 0.0 AC Hrs: 17.6	AC Hrs: 8.4

C JET "A" (VF/VA)

CPT: NONE	CPT: 2C19	OPT: 2F23	AC T-2A

BASIC JET "A" ACADEMICS				
TRANSITION		PRECISION/ACROBATICS	BASIC INSTRUMENTS	RADIO INSTRUMENTS
CPT Hrs: 8.0	OPT Hrs: 0.0	OPT Hrs: 9.0	OPT Hrs: 8.0	OPT Hrs: 7.5
CPT Hrs: 6.0	AC Hrs: 17.6	AC Hrs: 7.3	AC Hrs: 16.5	AC Hrs: 9.0

BASIC PROP (VF/VP)

CPT 12BK14	CPT NONE	CPT 2B21	AC T

BASIC PROP ACADEMICS			
TRANSITION	Precision/Acrobatics	BASIC INSTRUMENTS	RADIO INSTRUMENTS
CPT Hrs 3.0 OPT Hrs: 8.0 CPT Hrs: 0.0 AC Hrs: 11.7	OPT Hrs: 0.0 AC Hrs: 18.2	OPT Hrs: 12.0 AC Hrs: 14.8	OPT Hrs: 10.8 AC Hrs: 14.5

RIGHT FAM	
OPT Hrs. 0.0	
AC Hrs. 2.8	

BRAB TERM SYSTEM

PRIMARY

CPT: 12BK13	CPT: NONE	OPT 2FT34(C)	AC T-34

PRIMARY ACADEMICS	
PRESOLO	Precision
CPT Hrs: 3.0 OPT Hrs: 5.2	OPT Hrs: 1.5
CPT Hrs: 0.0 AC Hrs: 12.4	AC Hrs 6.9

BASIC JET (VF/VA)

CPT 12BK1C	CPT 2CT2C	OPT 2F1?(A)	AC T-2B C

BASIC JET ACADEMICS				
TRANSITION	Precision Acrobatics	BASIC INSTRUMENTS	INSTRUMENT NAVIGATION	FORMAT
CPT Hrs. 2.0 OPT Hrs 3.3 CPT Hrs 8.0 AC Hrs 13.3	CPT Hrs 6.5 AC Hrs 6.0	OPT Hrs 13.5 AC Hrs 7.5	OPT Hrs 24.0 AC Hrs 16.8	CPT Hrs AC Hrs

RIGHT FAM	APPL INST NAV	NAVIGATION
OPT Hrs 0.0 AC Hrs 3.0	OPT Hrs 1.5 AC Hrs 3.0	OPT Hrs 0.0 AC Hrs 6.0

BASIC PROP (VF/VP)

CPT 12BK14	CPT NONE	OPT 2B21	AC T-28B C

BASIC PROP ACADEMICS			
TRANSITION	Precision/Acrobatics	BASIC INSTRUMENTS	INSTRUMENT NAVIGATION
CPT Hrs 2.0 OPT Hrs 0.0 CPT Hrs 8.0 AC Hrs 10.4	OPT Hrs 0.0 AC Hrs 16.6	OPT Hrs 13.5 AC Hrs 7.5	OPT Hrs 10.5 AC Hrs 30.3

RIGHT FAM	APPLIED INS
OPT Hrs 0.0	OPT Hrs
AC Hrs 2.8	AC Hrs

PAR TERM SYSTEM

PRIMARY

CPT 12BKVTP	CPT-2CVTP	OPT 2FVTP(A)	OPT 2FVTP(B)	AC VTP(T)

PRIMARY ACADEMICS				
PRESOLO	Precision/Acrobatics	BASIC INSTR	INSTRUMENT NAV	FORMATION
CPT Hrs: 2.0 OPT Hrs: 7.0 CPT Hrs: 5.0 AC Hrs: 8.5	OPT Hrs. 6.5 AC Hrs. 6.5	OPT: 4.4 AC: 14.4	OPT Hrs . .5 AC Hrs. 6.0	OPT Hrs 7.5 AC Hrs 10.5

RIGHT FAM	NAVIGATION
OPT Hrs. 0.0	OPT Hrs. 0.0
AC Hrs. 3.0	AC Hrs. 3.0

BASIC

CPT 12BKT2C	CPT 2CT2C	CPT 2F1?

BASIC ACADEMICS		
TRANSITION		INSTRUMENT NAVIGATION
CPT Hrs: 2.0	OPT Hrs 5.4	OPT Hrs 13.0
CPT Hrs 8.0	AC Hrs 8.9	AC Hrs 8.6

BASIC INSTR	Precision/ Acrobatics
OPT Hrs: 4.2	OPT Hrs 6.3
AC Hrs 2.8	AC Hrs 6.0

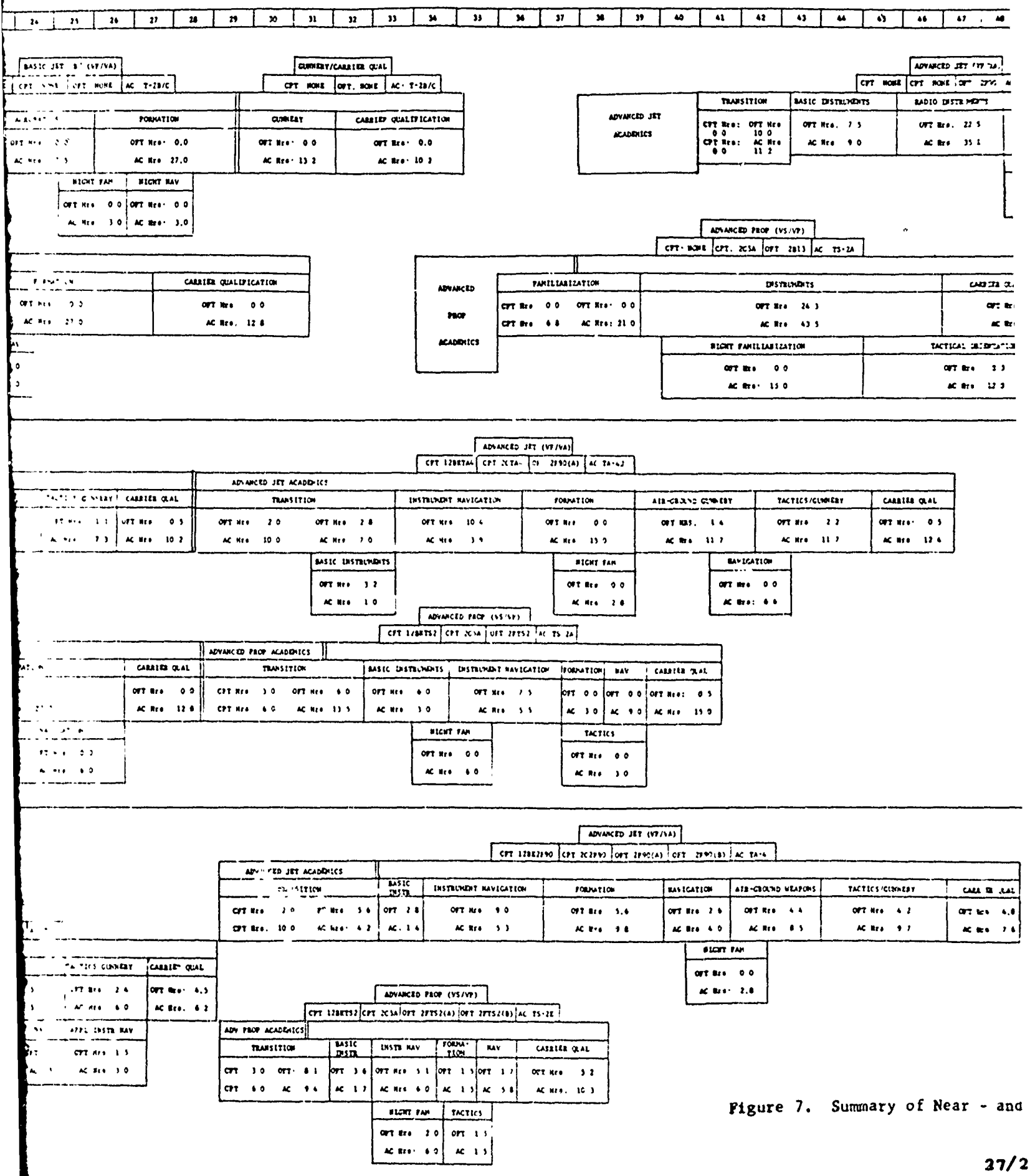


Figure 7. Summary of Near - and

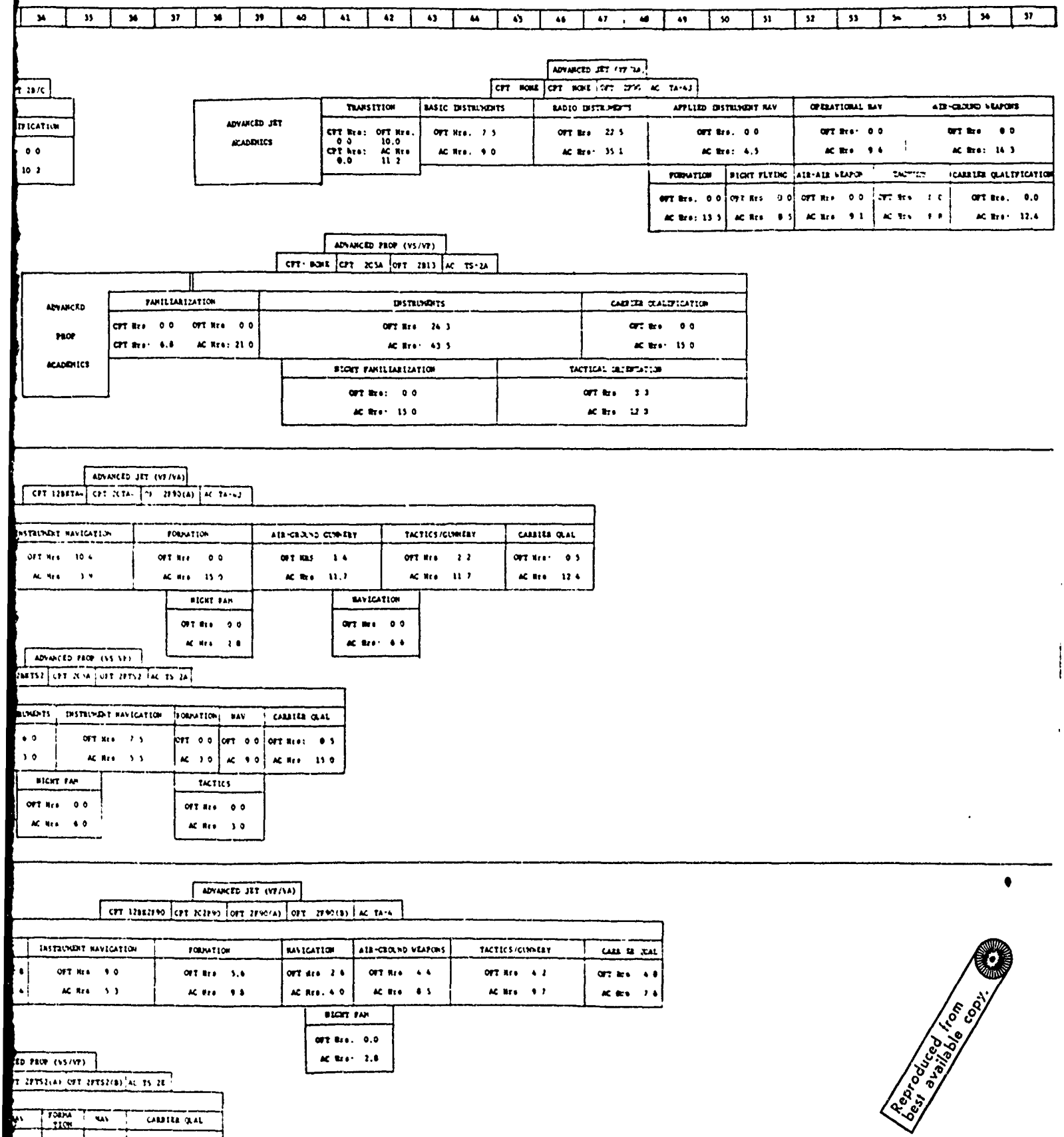


Figure 7. Summary of Near - and Far-Term Systems